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Contract: NAS8-35594

Subject: Monthly Progress Report--Development of a Global Model for Atmospehric Backscatter at CO_2 Wavelengths

Period: April 14 - May 13, 1984

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Technical Monitor, NAS8-35594

Introduction

Work has continued on the tasks shown below.

Task 1.2 To investigate the effect of aerosol microphysical processes occurring in an aerosol plume which undergoes transport in the atmosphere, on its β_{CO_2} value.

A ten-layer model is currently under development for the study on the effect of gravitational sedimentation on the aerosol size distribution. Figure 1 shows schematically the model layers. It includes ten 1 km thick layers above the earth surfaces. In doing this, we have introduced implicitly the assumption that the properties in each of the layers are homogeneous. Figure 1 also shows schematically the possible sink and source of the aerosol particles of a typical layer (#5) due to gravitational sedimentation (the arrows). In order to simulate, numerically, the sedimentation effect, it is also assumed that the background atmosphere in the top layer will not change its characteristics with time in the model. To test this model, we have used the initial size distinctions, given in Table 1, which are based on typical figures for a Saharan dust plume over the Atlantic Ocean [Savoie and Prospero (1977), Prospero and Carlson (1972); Savoie (1978)]. The layers 2 to 4 are specified as the dust layer. The time step of the numerical computation is set to 2 days. Currently, ten time steps have been successfully simulated. The time evolution of the aerosol size parameters of the 4th layer is given in Table 2. It shows distinctly the decreases of the aerosol particle concentration and also the log-normal mode radius. There is not much change in the geometric standard deviation (σ). Since this layer is at the top of the dust layer, such changes are anticipated. The results of this simulation will be further examined in detail.

Task 2.1 Use of the SAGE/SAM II Data Set

Work has continued on the study of the SAGE/SAM II data. The following has been accomplished.

1. Data for Spring 1979 has been examined in some detail and the latitude bands between 20°N and 60°N and 20°S and 60°S have been further subdivided in 20° bands. The tropospheric aerosol extinction within each of these bands shows a steady decrease from North to South, greatest differences occurred at altitudes of 5-7 km where the total range is about one order of magnitude (see Fig. 2).

2. Similar data sets for Spring 1980, Summer 1979 and Fall 1979 have been computed and, although these have not yet been examined in detail, it is apparent that the latitude variation of aerosol extinction in Spring 1980 closely resembles that for Spring 1979. In Summer and Fall 1979, the variation within the northern hemisphere is less but there still exists a strong difference between the two hemispheres, the Southern hemisphere showing less extinction.

3. Probability distributions for the aerosol extinction are under study. At the higher tropospheric altitudes, a clear distinction can be seen between aerosol and cloud. At the lower levels, the distinction is less obvious and a simulation program has been written to assist with the interpretation of the distributions.

Research Schedule for Next Month

1. To continue work on the multi-layer numerical model described under Task 1.2

2. To continue work on the SAGE/SAM II data set:

   a. Complete testing of SAM II program

   b. Process and examine one complete year of SAGE data

   c. Process a second year of SAGE data

   d. Improve aerosol/cloud probability distribution simulation and apply to interpretation of actual data.

Remarks

No problems encountered.

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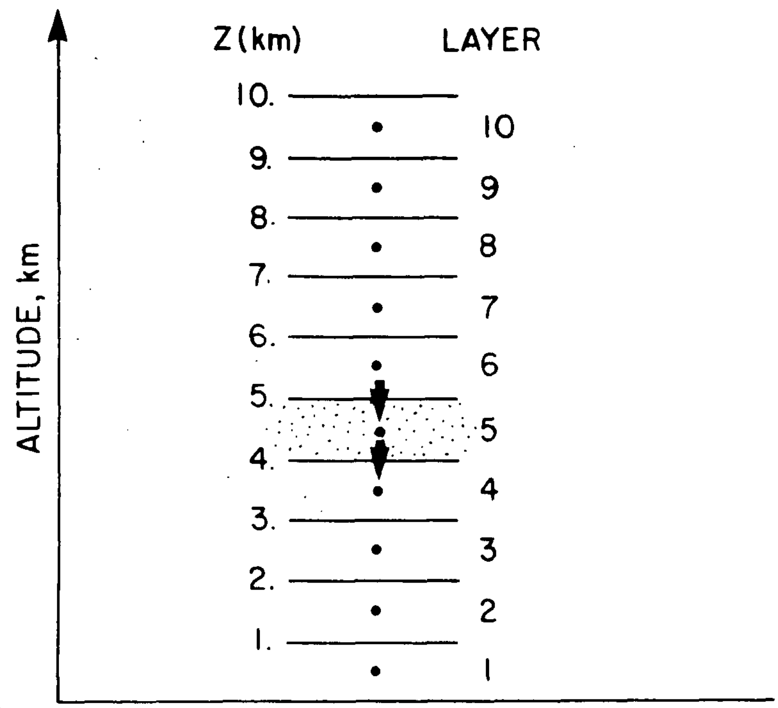

Fig. 1. Schematic diagram shows the 10-layer model for numerical study of the aerosol transport. The arrows indicate the interaction of aerosol size distribution between successive layers through the effect of gravitational sedimentation.

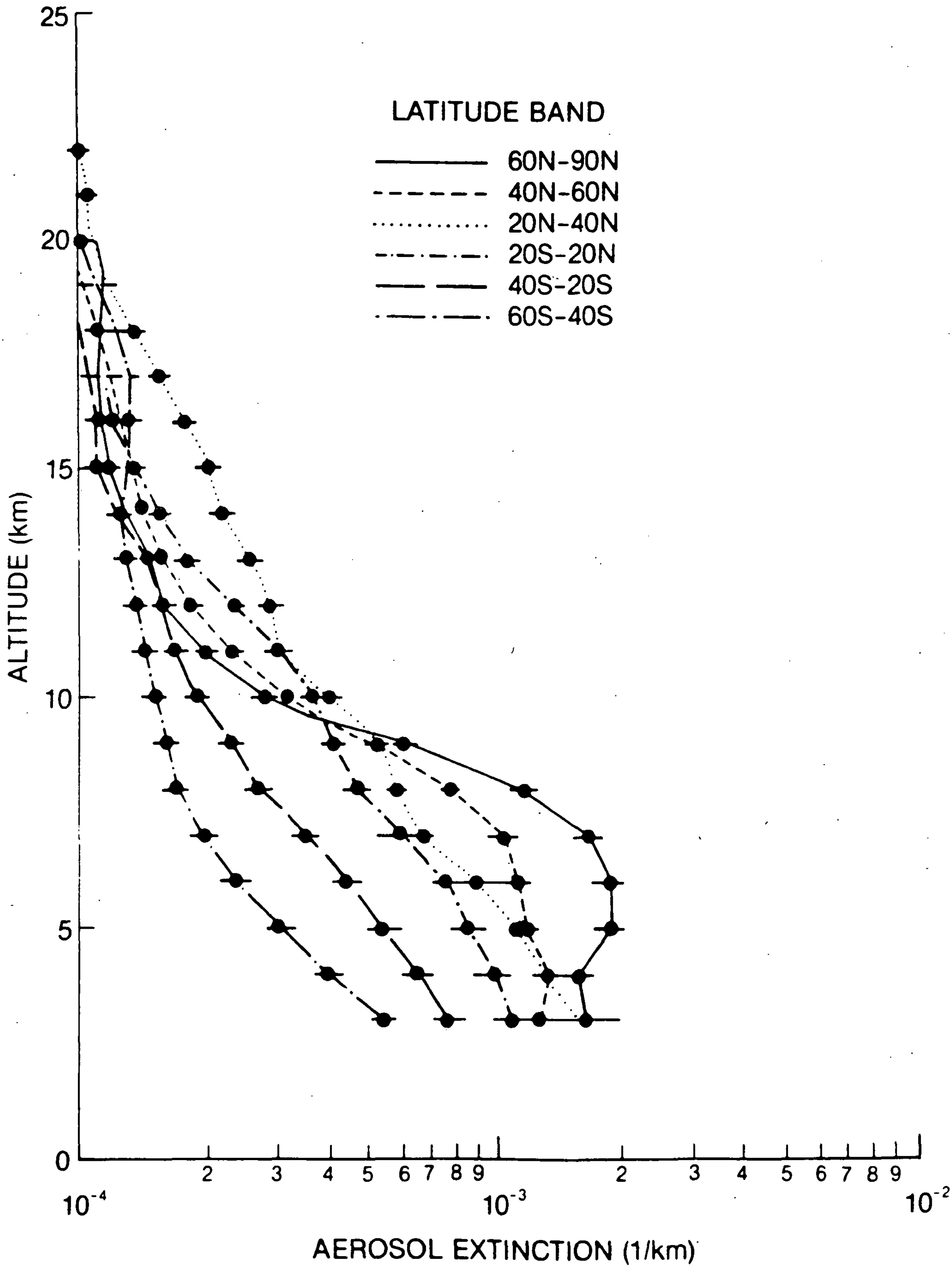

Fig. 2. Latitude variation of median aerosol extinction (SAGE, 1 μm, March-May 1979)

TABLE 1. Initial Size Distribution

Layers No.	No. Concentration (No./cm^3)	Log-normal Radius Mode (μm)	Geometric Standard Deviation σ
1	7.0	0.3	2.512
2 to 4	10.0	1.0	2.0
5 to 10	0.2	0.5	2.995

TABLE 2. Time Variation of Aerosol Size Distribution of the 4th Layer

Time Step (2 days)	No. Concentration (No./cm^3)	Log-normal Radius (μm)	Geometric Standard Deviation σ
Initial	10.0	1.0	2.0
1	9.85	.825	1.87
2	9.04	.796	1.86
3	8.36	.780	1.86
4	7.80	.768	1.85
5	7.30	.757	1.86
6	6.87	.748	1.86
7	6.49	.741	1.86
8	6.16	.735	1.86
9	5.86	.730	1.86
10	5.59	.725	1.87

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